Report on the Impacts of Beach Maintenance and Removal of Vegetation under Act 14 of 2003

Michigan Department of Environmental Quality

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Contents

This report was prepared by staff of the Department of Environmental Quality – Land and Water Management Division to meet the requirements of Public Act 14 of 2003. Information contained in this report includes a summary of research carried out during 2004 and 2005 by Dr. Thomas M. Burton, Michigan State University; Dr. Donald G. Uzarski, Grand Valley State University; and Dr. Dennis Albert, Michigan Natural Features Inventory – Michigan State University Extension. We greatly appreciate their technical assistance, and their permission to use the photographs and diagrams included in this report. Any inadvertent misinterpretation of their data is the responsibility of DEQ staff. Their full technical reports are attached.

Executive Summary

Part 303 – Wetlands Protection, and Part 325 – Great Lakes Submerged Lands, of the Natural Resources and Environmental Protection Act were amended in 2003 by Public Act 14 to streamline authorizations for beach maintenance and vegetation removal activities between the ordinary high water mark of the Great Lakes and the water's edge. These amendments were in response to riparian property owner complaints regarding increased growth of vegetation along the coast resulting from low water levels in the Great Lakes. Recognizing that there are ecological concerns associated with alteration of coastal wetlands, and realizing that low water levels are not a permanent condition, the Legislature placed both geographic and time limits on the provisions of Act 14. Moreover, the Department of Environmental Quality (DEQ) was required to evaluate the impacts of vegetation removal and report back to the Governor and the Legislature by January 1, 2006. The following report fulfills that requirement.

Under the provisions of Act 14, property owners in two pilot areas – Saginaw Bay and Grand Traverse Bay could be authorized to remove vegetation from shoreline areas under a Letter of Approval from the Director of the DEQ, provided that specified conditions were met. This provision will sunset on June 3, 2006. Act 14 also exempts defined "beach maintenance" activities, including mowing, raking, leveling of sand, and establishment of paths to open water until November 1, 2007.

The DEQ has been tracking the number of requests for Letters of Approval since the law was enacted in 2003. During this period, the DEQ authorized 78 of the 90 requests received. The remainder failed to meet legislatively defined criteria, or did not include complete information. The number of requests in 2005 declined in comparison to 2004 (24 as opposed to 48).

In order to evaluate the ecological impact of vegetation removal and beach maintenance, the DEQ requested the assistance of research scientists from Michigan State University and Grand Valley State University with expertise in coastal ecology. The research team evaluated the impacts of these activities during 2004 – 2005 by comparing impacted sites with nearby unaltered (reference) sites. Their findings are presented in this report and include the following:

- Clearing a swath of vegetation through a coastal marsh produces a fundamental change in the chemical and physical conditions in nearshore waters.

- These changes in turn negatively impact the larval (very young, immature) forms of important game fish, reducing or eliminating habitat for species including yellow perch, smallmouth bass, and largemouth bass.

- Adult fish netted adjacent to undisturbed areas were present in greater numbers and had higher diversity (numbers of species) than adjacent to "groomed" areas.

- Invertebrate communities (insects, snails, and other small organisms), upon which fish depend for food and nutrient cycling, were reduced by vegetation

removal and beach grooming. The number of individual organisms collected adjacent to undisturbed beaches was 29 times greater, on average, than adjacent to raked or cleared areas.

- Impacts to fish and invertebrate habitat can extend more than 150 feet on either side of a cleared area, impacting marshes in front of adjacent property owners.

- Beach raking, hand pulling of vegetation, disking, sand leveling, and (to an extent) repeated mowing were shown to rapidly destroy stands of ecologically important plants such as the bulrush, which is naturally deep-rooted and long-lived, and which serves to anchor underlying sand and soil. Where vegetation was allowed to regrow, shallow-rooted annual plants and invasive species colonized cleared areas; bulrush plants did not readily regrow.

- Qualitative observations indicate that the removal of vegetation increases the movement of sand and erosion of shoreline areas, but these impacts were not quantified under this study. Additional evaluation is needed.

Given these findings and the limited number of requests for permits to remove vegetation, the DEQ recommends the following:

1. **That vegetation removal under a letter of approval from the Director of the DEQ be allowed to sunset on June 5, 2006, as specified in Act 14. After that date, an individual permit evaluated on a case-by-case basis would be required.**

   The Department would typically recommend issuance of an individual permit for vegetation removal to control invasive species such as *Phragmites*; and to maintain recreational areas in public parks in accordance with approved management plans. Permits may also be issued on a case-by-case basis where a clear need is demonstrated, damage to coastal habitat and impacts to neighboring properties would be minimal, and mowing is not a viable alternative. Permits for vegetation removal will not be issued in designated Environmental Areas or where rare species would be impacted, except to control invasive species.

   The Department proposes development of a simplified permit application form for vegetation removal in cooperation with the Corps of Engineers. The Department anticipates action on completed applications within 60 days (well within the average Corps processing time of 151 days), with a goal of 30 days.

   Issuance of a limited General Permit for removal of vegetation from a 6 foot wide walkway to allow access to open water is also recommended (except within designated Environmental Areas or where rare species would be impacted).

2. **That exemptions for beach maintenance activities including raking, mowing, leveling of sand, and establishment of raised paths continue**

only until November 1, 2007, as specified in Act 14.

After this date certain beach maintenance activities will continue to be exempt under Part 303. These include: (a) manual de minimis removal of vegetation (hand pulling) in sparsely vegetated areas; (b) manual leveling of sand in unvegetated areas of beach above the current water's edge; and (c) manual raking of sand in unvegetated areas to remove debris, without disturbing or destroying plant roots.

The Department recommends issuance of a new General Permit as of November, 2007 to cover the following additional beach maintenance activities: (a) mowing of vegetation twice per season to a height of not less than two inches, in an area not to exceed 40 feet in width; (b) mechanical leveling of sand in unvegetated beach areas above the current water's edge; and (c) construction and maintenance of a temporary path up to 6 feet in bottom width to provide access to open water, to be constructed of sand and pebbles.

An individual permit would be required for other beach maintenance activities, including: (a) grading or leveling of sand that would alter the natural shoreline; (b) mechanical raking or disking of beach areas that will result in loss of vegetation or degrade habitat quality on the beach or in adjacent waters; and (c) large scale or frequent mowing that would significantly impact vegetation.

In evaluating permit applications, the impact on adjacent property owners and on public resources would be considered.

Permits for beach maintenance will not be issued in designated Environmental Areas or where habitat for threatened or endangered species would be adversely impacted, except to control invasive species under an approved management plan.

3. **That the DEQ provide additional information regarding the impacts of beach maintenance and vegetation removal to the public.**

4. **That the DEQ discourage the mowing of nuisance species such as *Phragmites* in order to reduce the spread of this serious nuisance species.**

5. **That the DEQ continue to support research regarding the impacts of human activity on Great Lakes coastal wetlands, with particular attention to groups of organisms that were not evaluated as a part of this study (e.g. shorebirds, waterfowl, reptiles and amphibians) as funding becomes available. Additional information is also needed on the extent of soil erosion and alteration of the physical nature of the shoreline following vegetation removal and related activities.**

Report on the Impacts of Beach Maintenance and Removal of Vegetation under Act 14 of 2003

Section I: Background Information

Water levels in the Great Lakes are subject to long term fluctuations. From 1997 to 2003, lake levels dropped by more than one meter in Lakes Michigan and Huron, reaching near record lows in 2003. During these years, declining water levels exposed normally inundated Great Lakes bottomlands, stimulating the growth of wetland vegetation.

The regeneration of vegetation during low water years is a normal component of wetland and nearshore ecology, and is moreover essential to the maintenance of healthy wetland ecosystems in the long term. Coastal wetlands, including exposed and vegetated Great Lakes bottomlands, are considered to be the most valuable ecological areas in the Great Lakes. In addition to songbirds, amphibians, reptiles, and mammals, coastal wetlands provide habitat for 90% of the nearly 200 Great Lakes fish species and two dozen waterfowl species which help fuel a two-billion dollar hunting, fishing, and wildlife watching industry. Coastal wetlands also protect water quality by absorbing polluting nutrients that can aggravate growth of unwanted algae, and they reduce erosion and sediment suspension by absorbing wave action along the shoreline.

However, given the extreme low water levels leading up to 2003, a relatively broad band of vegetation became established along some shorelines, and a number of property owners expressed the need to remove vegetation that they viewed as impeding access to open water. In addition, the growth of invasive plant species such as purple loosestrife and *Phragmites* (common reed) has expanded significantly in some areas.

In the fall of 2002, the Michigan Department of Environmental Quality (DEQ) and the Detroit District Corps of Engineers (Corps) together with several property owner and environmental interest groups formed a Shoreline Task Force to address beach maintenance during low water years. Concerns included the regulation of vegetation management by state and federal agencies, provisions for access to open water, and related beach management issues. The Shoreline Task Force issued a "Consensus Document" on April 8, 2003. The Consensus Document recognized the value of coastal wetlands, but also recommended that the Corps and the DEQ attempt to identify a simplified and expedited permit process for regulated activities.

Public Act 14 of 2003.
As the Corps and the DEQ were in the process of implementing the recommendations of the Shoreline Task Force, the Michigan Legislature passed Public Act 14 in June of 2003. This Act amended Part 303 – Wetland Protection, and Part 325 – Great Lakes Submerged Lands, to address beach maintenance and removal of vegetation between

the ordinary high water mark of the Great Lakes and the water's edge. Public Act 14 defines these activities as follows:

> **"Beach maintenance activities"** means any of the following in the area of Great Lakes bottomlands lying below the ordinary high-water mark and above the water's edge:
>
> (i) Manual or mechanized leveling of sand (further defined as the relocation or grading of sand within areas that are predominantly free of vegetation).
>
> (ii) Mowing of vegetation (further defined as cutting of vegetation to a height of not less than 2 inches, without disturbing plant roots).
>
> (iii) Manual *de minimis* removal of vegetation.
>
> (iv) Grooming of soil (further defined a raking the top 4 inches of soil without disturbing plant roots, for the purpose of removing debris).
>
> (v) Construction and maintenance of a path (further defined as a temporary access walkway from riparian property to open water not exceeding 6 feet in bottom width and consisting of sand and pebbles obtained from non-vegetated areas).
>
> **"Removal of vegetation"** means the manual or mechanized removal of vegetation, other than the manual *de minimis* removal of vegetation."

Under the provisions of PA 14:

- **"Beach maintenance activities"** are exempted statewide (except in designated Environmental Areas) provided that mowing does not exceed the width of the riparian property or 100 feet (whichever is less), and all debris is disposed of properly outside of any wetland.

- The exemptions provided for beach maintenance activities expire on November 1, 2007.

- **"Removal of vegetation"** may be authorized under a general permit in response to an application by a local unit of government or a group of adjacent riparian property owners.

- **"Removal of vegetation"** is allowed within two pilot areas defined by the Director of the DEQ providing that the following conditions are met:

  (a) The landowner has received a letter of approval from the DEQ confirming at least three of the following:

  (i) The area is unconsolidated material predominantly composed of sand, rock, or pebbles, or is predominantly vegetated by non-native or invasive species.

(ii) The area met the requirement of paragraph (i) as of January 1, 1997.

(iii) The removal of vegetation does not violate Part 365 or rules promulgated under that part, or the endangered species act of 1973, Public Law 93-205, or rules promulgated under that act.

(iv) The area in which removal of vegetation may occur is not an environmental area.

(b) The area in which removal of vegetation may occur does not exceed 50% of the width of the riparian property, or 100 feet, whichever is greater, or a wider area if approved by the Director.

(c) All collected vegetation shall be disposed of properly outside of any wetland.

- The provisions for removal of vegetation within pilot areas under a letter of approval from the Director expire June 5, 2006 (three years from the effective date of Act 14).

Finally, Public Act 14 requires an evaluation of these activities, and a report to the Governor and the Legislature:

> "By January 1, 2006, the director shall prepare and submit to the senate majority leader, the speaker of the house of representatives, the standing committees of the legislature with jurisdiction primarily related to natural resources and environment, and the governor a report that evaluates the activities allowed under subsection (1), describes the impacts to the affected areas, and recommends statutory changes based upon the evaluation, if appropriate.

This report has been prepared and submitted to fulfill the requirement of Public Act 14.

Section II: Implementation of Public Act 14

Public Act 14 was given immediate effect on June 5, 2003. Information for property owners explaining provisions of the Act was posted on the DEQ website at www.michigan.gov/deqwetlands. In addition, a pamphlet outlining regulatory requirements associated with beach maintenance and vegetation removal, and the ecological basis for those regulations, was prepared and distributed directly to all property owners in Grand Traverse Bay and Saginaw Bay[1].

On June 17, 2003, the Director defined Saginaw Bay and Grand Traverse Bay as the two pilot areas where vegetation removal would be authorized by a Director's letter. Maps of the pilot areas are posted on the DEQ wetlands website.

Beach maintenance activities.
Because Act 14 exempts these activities, the Department has no way of knowing how many property owners took advantage of the exemptions, or to what extent coastal areas were impacted. It has been observed, however, that the impact of beach maintenance activities carried out under the Act 14 exemptions varies considerably from one site to another, as shown below.

Figure 1. Undisturbed reference site.

Figure 2. Mowed site.

[1] Educational materials were developed and distributed in cooperation with the Tip of the Mitt Watershed Council with funding from the U.S. Environmental Protection Agency and the Great Lakes Fishery Trust. Additional technical assistance was provided at the local level by Michigan Sea Grant.

Figure 3. Site showing the impact of mowing in the previous year (background) as compared to mowing in the current year (foreground).

Figure 4. Mechanically raked site (foreground) compared to natural area (background).

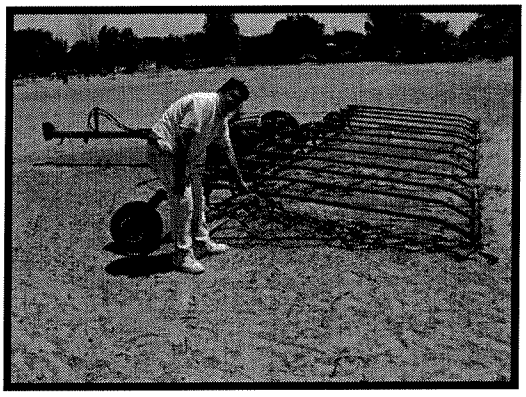

Figure 5. Mechanical rake.

Figure 6. Site that has been filled with sand (or "leveled") and graded (foreground) compared to natural marsh (background).

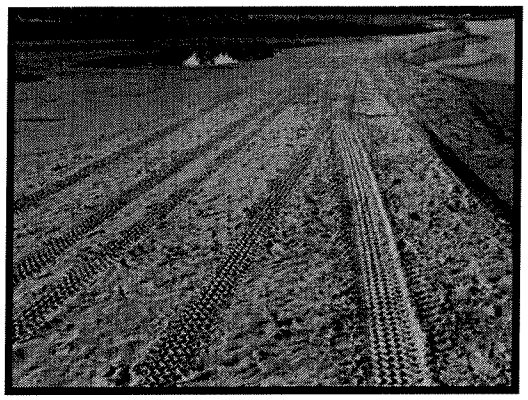

Figure 7. Site that has been mowed and raked. (Natural marsh in background.)

Figure 8. Site that has been mowed only.

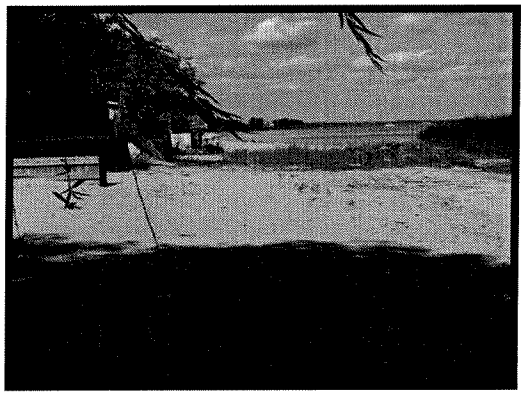

Figure 9. Site altered by hand pulling of vegetation and mowing.

Removal of vegetation under a Director's letter of approval.

Act 14 allows for removal of vegetation from the two designated pilot areas under a letter of approval from the Director of the DEQ, provided that specified conditions are met (as outlined above). Removal of vegetation is typically carried out mechanically.

Figure 10. Mechanical removal of vegetation.

In 2003 the Department received a total of 18 requests for Director's letter approvals for vegetation removal.

The Department received 15 requests for Director's letter approval for vegetation removal within the Saginaw Bay pilot area in 2003. Thirteen requests were approved, one was denied because it did not meet the requirements in Section 32516 (a), and one request was incomplete and eventually closed when the applicant did not respond to requests for additional information.

Three requests for Director's letter approvals were received and issued in the Grand Traverse Bay pilot area in 2003. In addition, 3 permit applications were received and issued within the Grand Traverse Bay pilot area for vegetation removal exceeding the limits for Director's letter approval along with other regulated activities such as filling or grading.

During 2003, three applications were also received for vegetation removal or mowing exceeding the exemption, outside of the pilot areas in Delta and Iosco counties. One application for vegetation removal outside the pilot areas was denied due to the presence of high quality wetland habitat and the availability of feasible and prudent alternatives. One permit was issued for mowing vegetation, and one application was withdrawn by the applicant.

In 2004 the Department received a total of 48 requests for Director's letter approvals for vegetation removal within the two pilot areas.

Forty-six requests for Director's letter approvals were received within the Saginaw Bay pilot area. Thirty-seven requests were issued, and 9 were denied because they did not meet the requirements in Section 32516 (a). Three permits were issued within the pilot

area for mowing which exceeded the limits of the exemption, and 1 permit was issued for vegetation removal plus dredging and filling activities.

Two requests for Director's letter approvals were received and issued with the Grand Traverse Bay pilot area during 2004.

In 2004 two applications were received outside of the pilot areas, in Delta and Menominee counties, for mowing of vegetation in excess of the exemption. Both permits were issued.

In 2005 there was a significant reduction in the number of requests for Director's letter approvals for vegetation removal within the pilot areas, with a total of only 24 requests.

The Department received 16 requests for Director's letter approvals within the Saginaw Bay pilot area. All of the requests were approved. In addition, two applications were received for work which didn't qualify for Director's letter approval. One application was for mowing in excess of the exemption, and the other was for vegetation removal plus fill. Permits were issued for both projects.

Eight requests were received for Director's letter approvals within Grand Traverse Bay pilot area. Seven requests were approved. One request was incomplete and closed because the applicant failed to respond to requests for additional information.

In 2005, eleven applications were received for vegetation removal or mowing outside of the pilot areas. They were located in Menominee and Alger counties. Nine permits were issued, and one was just recently received and is still under review. One application was incomplete and closed because the applicant failed to respond to requests for additional information.

Prior to and following passage of Act 14 there was confusion among lakefront landowners and some misleading information published in the press. Because of this, the Department decided not to pursue enforcement action against landowners who removed vegetation without permits or Director's letter approvals. Instead, landowners were sent advisory letters explaining beach maintenance activities, and were encouraged to either stop the unauthorized activities or apply for the proper authorization.

General permits for removal of vegetation.

In the spring of 2004, Bangor and Kawkawlin Townships, both in Bay County, submitted applications for mowing and removal of vegetation under a General Permit. The DEQ could not process these requests because a General Permit for these activities did not yet exist. The Leelanau County Board of Commissioners and the Grand Traverse County Board of Commissioners considered applying for General Permit authorization, but ultimately voted against doing so.

On July 30, 2004, the DEQ released a Draft General Permit for public review and comment. The public comment period ended September 13, 2004. During the public

comment period, 568 comments were received, including information from scientists, property owners and landowner organizations, environmental groups, and others. There were 37 comments in favor of the General Permit, and 530 that opposed issuance of the General Permit. One took no position.

The department considered these comments as well as information from other sources regarding the ecological functions of coastal wetlands. Ultimately, the Department concluded that a General Permit for vegetation removal should not be issued, since the potential impacts are not similar in nature, and because it could not be concluded that these activities would have only minimal environmental impacts when performed separately or cumulatively. In addition, it was determined that issuance of a General Permit was not in the public interest.

Section III: Scientific Evaluation of Vegetation Removal Activities

The DEQ requested the assistance of Dr. Thomas M. Burton of Michigan State University; Dr. Dennis Albert of the Michigan Natural Features Inventory -- Michigan State University Extension; and Dr. Donald G. Uzarski of Grand Valley State University to provide an objective, scientific evaluation of the impacts of beach maintenance and vegetation removal. These research scientists have extensive experience with the aquatic ecosystems in Great Lakes coastal waters, and the evaluation that they proposed both built upon and expanded their ongoing research. The Department entered into an agreement with this research team to carry out agreed upon studies with a focus on Grand Traverse Bay and Saginaw Bay. Funding to support this work was obtained from the federal Coastal Management Program, with matching funds provided by the two universities.

Complete technical reports from these studies are included with this report as,

- Attachment A: *The Effects of Coastal Wetland Fragmentation on Ambient Chemical/Physical Parameters and Fish and Invertebrate Communities,* and
- Attachment B: *The Impacts of Various Types of Vegetation Removal on Great Lakes Coastal Wetlands of Saginaw Bay and Grand Traverse Bay.*

Study Design

Beach maintenance and the removal of vegetation fragment natural coastal wetlands by creating intermittent open areas along the beach and in shallow water. The overall goal of studies carried out during the summers of 2004 and 2005 was to explore the impact of wetland fragmentation on the chemical and physical characteristics of the shore, and on biological communities (plants, fish, and invertebrates). The data that was collected was statistically evaluated, and the results were used to assess the overall impact of beach maintenance and vegetation removal on public resources.

The study compared sites that had been altered by vegetation removal or beach management with similar, nearby, unaltered – or "reference" sites. The same measurements were made at each pair of sites – i.e. at the altered site and at the unaltered reference site. The majority of site pairs were located on Saginaw Bay. Fewer sites on Grand Traverse Bay were available due to the more limited extent of natural wetlands along that coast, a lower level of beach maintenance activity, and because of the refusal of some property owners to allow sampling. Some sites in Northern Lake Huron were also included in the study to evaluate the impact of wetland fragmentation from other activities, such as establishment of boat channels through the marshes. A total of 68 sites on Saginaw Bay, 7 sites on Grand Traverse Bay, and 23 sites in Northern Lake Huron were evaluated by the research team.

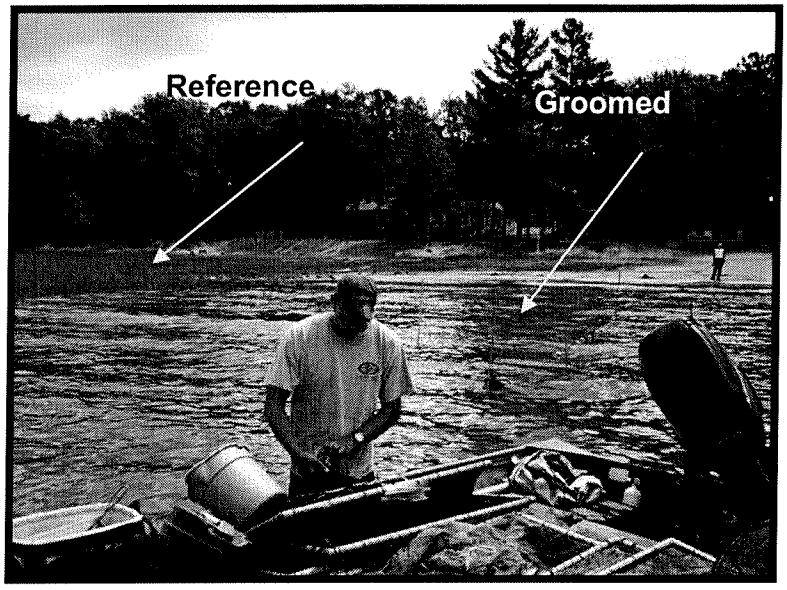

Figure 11. Sampling location near Caseville, Michigan, showing paired reference and groomed sites.

At each location, basic water chemistry measurements were made, along with measurements of physical conditions such as temperature and depth, and observations of the substrate (bottom material) present (e.g. sand or clay). Numerous biological samples were collected from paired sites in appropriate locations, and included fish (both adult fish and larval fish); plants, plant roots and rhizomes (underground stems); and invertebrates. Field work was initiated in the summer of 2004, and continued through the summer of 2005. Detailed methods are defined in the technical reports.

Summary of results

1. Chemical and physical changes.

Removal of vegetation disrupted the normal physical and chemical conditions of the wetlands. In undisturbed (reference) areas, water chemistry close to the shore is very similar to that of groundwater, because groundwater is entering the lake at this point. In addition, shallow areas that are somewhat sheltered from wave action by wetland plants warm more readily than open waters, and dissolved oxygen concentrations vary with the level of biological activity. In the outer portions of undisturbed areas -- that is, farther away from the shore – the chemistry and temperature of the water are quite similar to that of the open lakes, and the wave action is greater. Between the outer edge of the marsh and the inner marsh at the waters edge, there is a gradient of chemical and physical conditions.

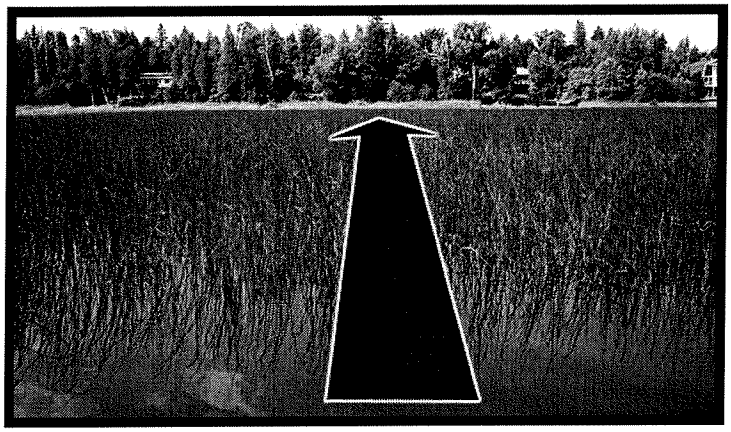

Figure 12. Water chemistry and physical conditions normally change from the outer edge of the marsh in a gradient toward the shoreline. Water chemistry near the shore resembles groundwater, while the chemistry of the open edge is essentially that of the open lake.

The numbers and types of fish and other animals in the marsh at any point are related to the chemical and physical conditions at that point, and change along the gradient from open waters to the shore. For example, larval (very young immature) yellow perch numbers are higher within the marsh than near the open water, with highest numbers occurring about 50 meters (164 feet) into the marsh.

Removal of vegetation alters this natural physical and chemical gradient. Removing vegetation opens a marsh to wave action from the lake, generating water chemistry, temperature, and other physical conditions similar to that of the open lake all the way to the shore. This change eliminates the zone where certain animals are normally located. (Figure 13). Moreover, conditions in the adjacent vegetated marsh were also changed by lateral movement of open lake water into the marsh.

Figure 13. Site where vegetation has been removed, allowing the waters of the open lake to move into the marsh, altering normal chemical conditions in the wetland and creating greater exposure to wave energy.

Data that demonstrates changes in water chemistry --- dissolved oxygen levels, pH, hardness, nutrient levels, and other parameters --- is presented in the attached technical reports.

Impact of vegetation removal on erosion. One of the goals of the 2004-5 studies was to evaluate the extent of erosion following removal of vegetation. While the research team made qualitative observations regarding erosion, the direct comparison of erosive impacts in paired sites could not be reliably measured due to the dynamic nature of the shoreline. Wave action and shoreline currents regularly move sand, so that detailed and consistent measurements cannot be readily made. For example, the erosion of surface sand exposing the underlying clay layer was observed at some sites where vegetation was removed; however, wave action subsequently moved some sand back into these locations. At other sites, sand was deeper with no underlying clay layer, and thus more difficult to evaluate. Erosive action will also vary as Great Lakes water levels rise and fall. An assessment of the overall impact of vegetation removal on erosion rates would thus require numerous measurements over time, and was beyond the scope of this study.

The research team did report that active wetland alteration – by raking, hand pulling of plants, or filling and grading of wetland swales along the beach – appeared to result in more rapid erosion of coastal sediments. The research team also observed apparent erosion where swaths of bulrush beds were removed; the water depth in these recently opened areas was somewhat greater than the depth in the adjacent vegetated marsh. No statistical analysis was made.

DEQ permit staff also made note of apparent erosion of the shoreline along Grand Traverse Bay where vegetation had been removed. They noted that the waterline moved landward wherever beach grooming had occurred.

2. Impacts on Aquatic Vegetation.

The most characteristic plant in the coastal marshes of Grand Traverse Bay and Saginaw Bay is the three-square Bulrush (*Schoenoplectus pungens*). This plant dominated 21 of 24 transects in normally vegetated areas of these marshes.

This bulrush is a perennial plant characterized by the formation of a thick mat of roots and rhizomes – or underground stems. The roots include a mass of fine root hairs near the surface, which help to bind sand in place, as well as thicker vertical roots that penetrate into deeper soils including clay or gravel where these materials are present. Rhizomes are thick, horizontal underground stems that also penetrate into deeper soils, and that persist over the winter. Rhizomes may be many feet long; the bulrush stems grow upward from the rhizomes during the growing season. Rhizomes also become thicker with age, providing a general means of evaluating the maturity of a stand of bulrushes.

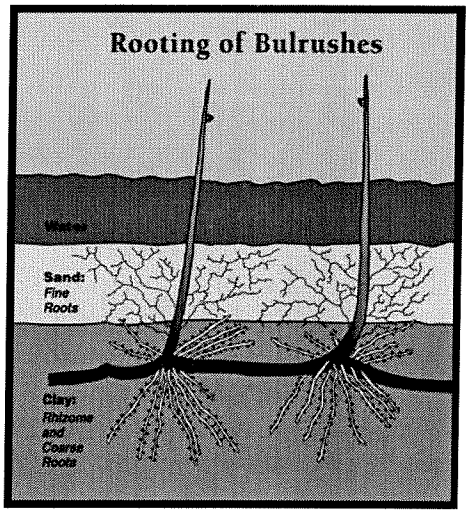

Figure 14. Diagram of bulrush roots and rhizomes.

Figure 15. Cross-section of bulrush roots from a soil pit, showing fine roots at the surface, rhizomes below, and vertical roots at bottom. Fine roots are concentrated in surface sand. Thicker rhizomes and vertical roots extend into underlying clay (if present).

The impact of beach management and vegetation removal was evaluated by counting the number and species of plants in standard plots laid out along a line or transect through the sampling location, and also by digging pits and removing a standard amount of root material. Various types of plant roots were separated and weighed to evaluate the mass of material present.

Detailed records of the vegetation that was sampled, and comparisons of plots from reference sites and managed areas are included in the technical report (Attachment B). Overall findings included the following:

- Disking, raking, filling of wetland swales with sand ("leveling"), and hand-pulling were all effective at killing aquatic plants. Rhizomes and roots of perennial aquatic plants decomposed rapidly following these forms of treatment. (See Figures 16 and 17).

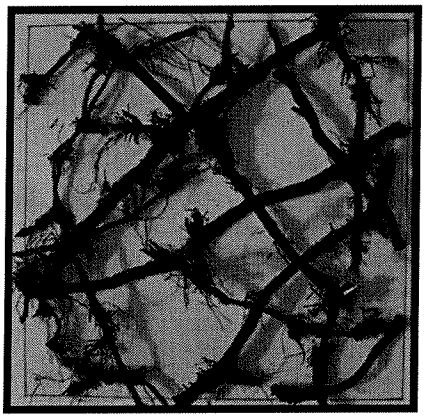

Figure 16. Normal bulrush rhizomes (underground stems) from a 30 cm X 30 cm soil pit, with fine roots removed.

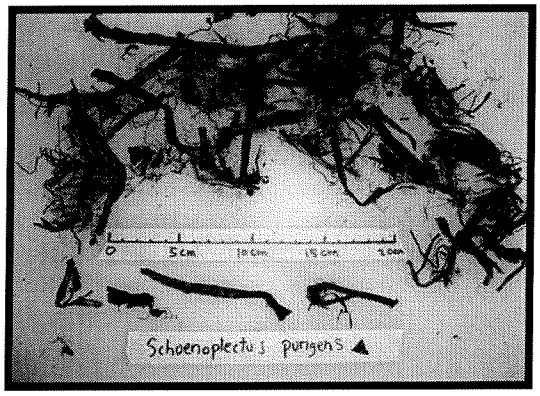

Figure 17. Decomposing bulrush rhizomes within a month or two following filling and raking of wetland swale.

- Plant diversity (the number of species present) is much higher in undisturbed areas with no active management, or in areas that were only mowed (although mowing made it difficult for research staff to identify all plant species present).

- Mowing appears to reduce the mass of bulrush roots and rhizomes, but additional studies are needed to confirm this impact. At some mowed sites, "thatch" was removed by raking or disking, and this practice removed much of the root mass and some rhizomes. Based on preliminary observations and the reports of shoreline residents, repeated mowing is expected to reduce or eliminate bulrushes over the long term.

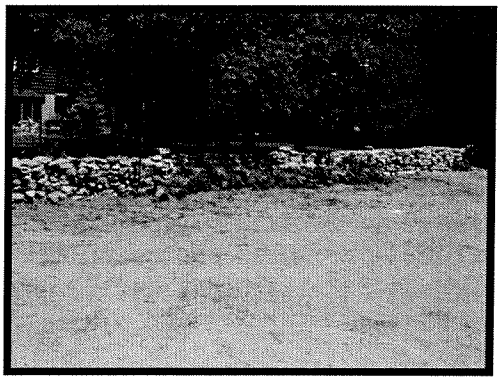

Figure 18. Site that has been mowed with "thatch removal".

- Within a year or two of disking, raking, or hand-pulling, some annual plants returned, along with invasive species. Annual plants tend to be shallow rooted, without the dense matt of roots and rhizomes which serve to stabilize the sand and sediment in bulrush beds. Plant diversity in previously disturbed sites tends to be low, and non-native or nuisance species, in particular *Phragmites* (common reed) are included in the plants that do occur. Bulrushes do not colonize disturbed shorelines as rapidly as annuals and exotics.

3. Effects on Invertebrates.

Invertebrate animals are critical to the overall ecology of the Great Lakes. These organisms are not only a significant component of the food web that ultimately supports fish and other higher animals, but as a group they are also cycle nutrients in the aquatic system by breaking down organic matter. Invertebrates are typically considered in two groups by size – "microinvertebrates" or microscopic organisms, and "macroinvertebrates" which are much larger and readily visible.

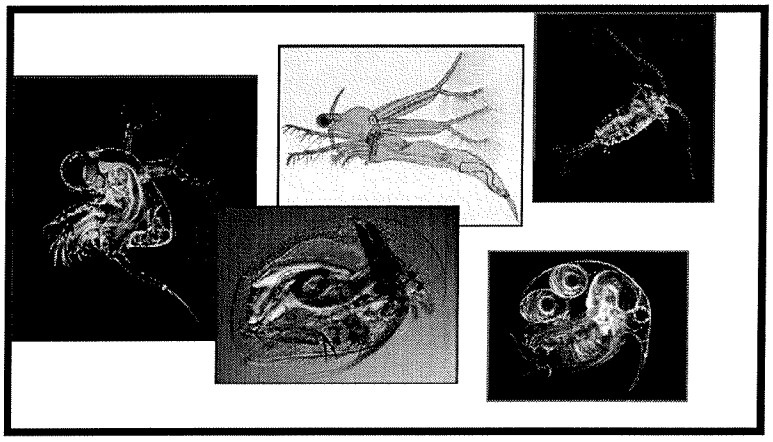

Figure 19. Typical microinvertebrates – microscopic animals – found in coastal Great Lakes waters.

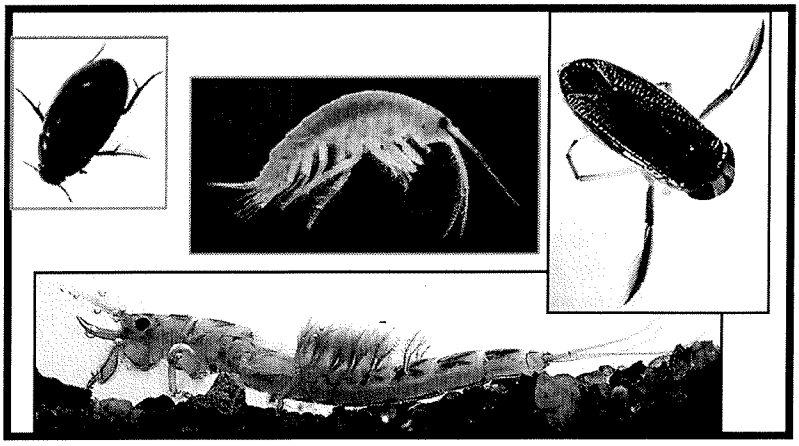

Figure 20. Typical macroinvertebrates. This group includes many kinds of insects, snails, clams, and similar organisms. Alteration of the numbers or types of these small animals can have a major impact on fish communities.

Macroinvertebrates were collected with dip nets in waters adjacent to normally unvegetated beaches, and adjacent to beaches that had been altered by raking or other removal of vegetation.

In addition, invertebrate samples were collected using light traps within vegetated marshes at specific points along two transects, one from the open edge of the marsh toward the shore, and one from the artificial edge (created by removal of vegetation) toward the center of the marsh.

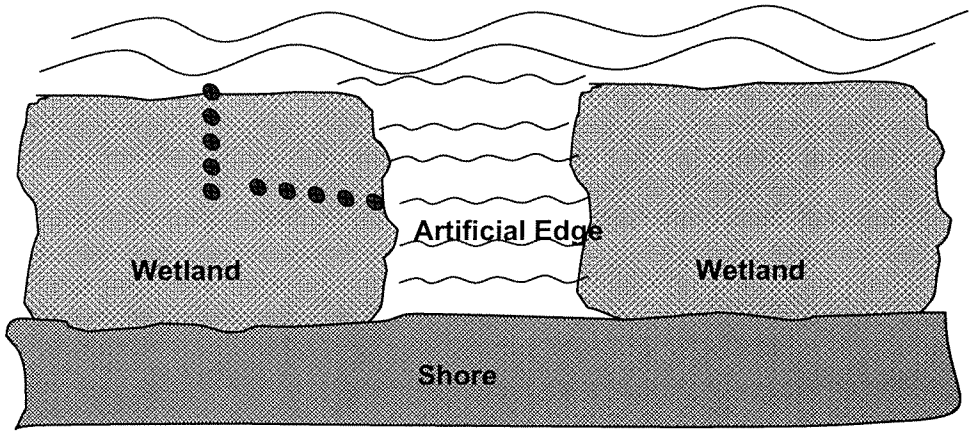

Figure 21. A fragmented Great Lakes fringing marsh showing the location of light traps for sampling larval fish and invertebrates (large red dots).

Details on invertebrate sampling methods, and a full statistical analysis of data from these samples is presented in the technical report (Attachment A). Comparisons of altered and unaltered sites during 2004 and 2005 led to the following overall conclusions:

- Mowing plant to heights above 5 cm (about 2 inches) during low water appears to cause few changes in the makeup of the invertebrate community, as long as the plant community is allowed to recover after mowing. Repeated mowing that significantly reduces or eliminates plant cover will, however, have the same impact as other forms of vegetation removal.

- The conversion of wetland plant areas to open water beaches --- by raking, disking, or other means --- results in very large and statistically significant decreases in the numbers of invertebrates present, and also in the diversity (number of kinds) of organisms that compose the invertebrate community. The number of individual organisms collected adjacent to undisturbed beaches was 29 times greater, on the average, than the number collected in raked zones. This has important potential ramifications in terms of reducing the potential food

base for nearshore fish communities in the Great Lakes.

- Transect sampling within marshes (as shown in Figure 21) demonstrated that macroinvertebrates were impacted not only at the point where vegetation was removed, but in adjacent unmanaged areas. In many cases, this impact extended up to 50 meters (about 164 feet) laterally from the artificial edge created by removal of vegetation. In other words, the abundance of invertebrate animals and the diversity of macroinvertebrates was reduced at adjacent properties in addition to the property where wetland vegetation was altered. Microinvertebrate impacts require additional study; however, data that is available suggests that this portion of the biological community is similarly impacted.

4. Impacts on fish.

The Great Lakes support nearly 200 species of fish. Of these, more than 90 percent utilize coastal marshes at some point in their lives.

Related studies of Great Lakes fish by members of the research team and their colleagues have suggested that coastal wetlands are likely to provide a critical refuge for native fish from invasive species such as round gobies:

> " Based on intensive fish sampling at more than 60 sites spanning all of the Great Lakes, round gobies have not been sampled in large numbers at any wetland or been a dominant member of any wetland fish community. So, it seems likely that wetlands may be a refuge for native fishes, at least with respect to the influence of round gobies. However, water levels are low and the invasion is in different degrees of maturity in different parts of the Great Lakes, so continued monitoring will be required to confirm this possibility" *(Jude, D.J., Albert, D., Uzarski, D.G., and Brazner, J. 2005. Lake Michigan's coastal wetlands: Distribution, biological components with emphasis on fish and threats. In M. Munawar and T. Edsall (Eds.). The State of Lake Michigan: Ecology, Health and Management. Ecovision World Monograph Series, Aquatic Ecosystem Health and Management Society. p. 439-477)*

Dr. Uzarski, Dr. Burton and their colleagues have also conducted a preliminary study on six drowned river mouth wetland-lake pairs where round goby have been documented. The results of the study indicated that wetlands always contained fewer round gobies than comparable habitat in the adjoining lake with surface water connection. In 2006, they will be expanding their study to fringing wetlands of Lakes Michigan and Huron. Additional studies that confirm the value of coastal wetlands as refuge areas for native fish would likely demonstrate an even greater basis for protection of this habitat.

Sampling of adult and juvenile fish

In this study, adult fish and juvenile fish were collected with fyke nets at paired reference (undisturbed) and altered sites.

Figure 22. Example of fyke net used to sample adult and juvenile fish. Six nets were set at each paired site.

Fish communities found at reference sites were clearly different than those found at beaches where vegetation had been altered. At both Saginaw and Grand Traverse Bays, the reference sites had higher fish diversity (i.e. a higher number of species), and a greater number of individuals of some species. Fish species that were present in higher numbers at reference sites than at mowed or groomed sites in Saginaw Bay included bluegill; white perch; brown bullhead; black buffalo; and various shiners and minnows. Detailed findings are presented in the technical report (Attachment A).

By contrast, fish collected in boat channels in Northern Lake Huron did not differ detectably from the fish community in adjacent wetlands. The channels were believed to be too narrow to alter the overall habitat requirements of adult and juvenile fish. However, boat channels did produce detectable difference in larval fish (very small fish that are not yet fully mobile, and are thus impacted by wave action and current to a great extent than older individuals).

DEQ permit staff also made qualitative observance of the loss of fish from small pools that were destroyed by leveling of beach areas in Grand Traverse Bay. Before these pools were eliminated, staff observed hundreds of minnows and other fish using the pools.

Larval fish evaluation.
Larval fish are very small, immature young fish that are essentially planktonic (carried by waves and currents). The larval stage of many Great Lakes fish species rely on the relatively protected conditions and abundant invertebrate food supply found in coastal marshes. Fish in this life stage were collected with light traps along transects within the marsh. As with invertebrates, the reference transect extended from the open water edge of the marsh toward the shore, while the other transect extended from the artificial edge created by vegetation removal laterally into the marsh. (See figures 21 and 24).

Figure 23. Collecting larval fish from a light trap within a Great Lakes coastal marsh.

As previously noted, different fish species are typically found at different locations within a natural undisturbed marsh. The preferred conditions for each species reflect water chemistry, physical characteristics (including substrate type and the amount of wave energy present), and the available food supply. Wave energy is greater on the lakeward edge of a natural marsh. Higher wave energy is also found nearer the artificial edge created by vegetation removal.

Again, detailed results and statistical analyses are presented in the technical report (Attachment A.) Overall results included the following.

- Larval yellow perch numbers consistently increased moving from the open water edge of the marsh toward the interior. Along the reference transect, the greatest numbers were found at 50 meters (about 164 feet) into the marsh.

  The numbers of larval yellow perch along the lateral transect clearly reflect the impact of vegetation removal. The numbers of yellow perch were generally lower along this transect – even though it was also located 50 meters from the open water side of the marsh (see Figure 24 below). This impact was not unexpected, since chemical and physical conditions near the artificial edge are similar to the open water edge.

  Fish numbers along the lateral transect varied considerably from one site to another. This suggests that some fragmented marshes may be more influenced by wave energy and lateral water movement than others (due to factors such as wind direction and depth of open water), with a parallel impact on larval fish.

- Larval smallmouth bass were most abundant at 30 meters (about 98 feet) from the open water edge of the marsh along the reference transect.

  However, smallmouth bass were not abundant at <u>any</u> point along the lateral transects, indicating that they were significantly impacted by vegetation removal and lateral movement of water into the marsh in all locations sampled. In other words, the lateral impact of open water had a large impact on larval smallmouth bass (figure 24).

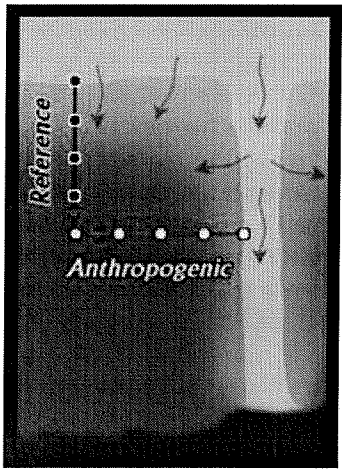

Figure 24. Generalized diagram of the movement of water from the open lake into a marsh, including lateral movement where the marsh has been fragmented by removal of vegetation. The term "anthropogenic" associated with the lateral transect refers to the fact that conditions have been altered by human activities.

- Larval largemouth bass were much more abundant farther away from the open water edge of the marsh, reaching a maximum number at 50 meters into the marsh. The same pattern was followed along the lateral transect --- that is, numbers increased with distance from the artificial edge.

- Larval killifish numbers increased toward the interior of the marsh in reference sites, with a maximum number at about 40 meters from open water. Along the lateral transect, no pattern was established. The numbers of fish present appeared to depend upon the extent of wave action resulting from vegetation removal.

- Some larval fish, such as Johnny darters, prefer a sandy habitat without vegetation, and such species *decreased* with distance into the marsh. No distinct difference was noted between number at the natural lakeward edge of the marsh and in areas where vegetation had been removed.

In summary, it is clear that the impact of vegetation removal on larval fish extends well beyond the point where vegetation has been removed. Most larval fish are less abundant near the *edge* of the marsh. This is true of the edge where vegetation is removed artificially, as well as the lakeward edge. Of particular interest and concern are the decreased abundance of some important sport fish – yellow perch, smallmouth bass, and largemouth bass.

Note that the chemical and physical impact of vegetation removal extends up to 50 meters (about 164 feet) laterally into the marsh. Thus, if a property owner leaves a zone of undisturbed vegetation 300 feet wide, but owners on either side remove vegetation, the infiltration of open lake water and increased wave energy from either side will impact the entire 300 foot "natural" zone. To view this another way, if a swath of vegetation is removed from a reach of shoreline every 300 feet, larval fish in the entire reach of shoreline will be impacted. "Fragmentation" of the marsh can thus have a very serious impact on fish production in the Great Lakes.

Section IV: Summary and Recommendations

The observations of DEQ permit staff, technical information provided to the Department in response to posting of a draft General Permit for vegetation removal, and most significantly, the findings of a research team that evaluated beach maintenance and vegetation removal over a two year period, all support the same conclusion. The alteration of vegetated areas on the Great Lakes coast between the ordinary high water mark and the waters edge has a significant adverse impact on the ecology of the Great Lakes.

Although only minor impacts were demonstrated where vegetation was mowed and then allowed to re-grow, repeated mowing was shown to reduce or eliminate stands of ecologically important plants such as bulrush. The removal of vegetation from the shoreline by this and other means, including raking, hand-pulling, disking, and mechanical clearing resulted in a reduction in invertebrates and fish in adjacent waters. Qualitative observations indicate that removal of vegetation also increases movement of sand and erosion of shoreline areas. Moreover, the limited vegetation that may re-grow following relatively minor beach disturbance tends to include exotic species and less valuable annual plants.

Clearing a swath of vegetation through a coastal marsh produces a fundamental change in the natural chemical and physical conditions in nearshore waters. Sheltered marsh zones having a low wave impact, and characterized by water chemistry similar to groundwater, are completely eliminated. These changes in turn impact both adult and larval fish species and the invertebrate communities on which they depend for food and nutrient cycling. Significantly, the removal of vegetation impacts not only the part of the shore that is directly altered, but also adjacent wetlands. Impacts can extend over 150 feet to either side of a cleared area. Thus, removal of vegetation along a reach of the shore every 300 feet will not only fragment but adversely impact the ecology and fish production along the entire reach.

While there may be circumstances where limited removal of vegetation is acceptable -- for example when invasive species are becoming established -- this activity should, in the future, be limited to those sites where qualified staff have determined that there is no feasible and prudent alternative and where ecological impacts will be minimal. **Therefore, the DEQ recommends:**

1. **That vegetation removal under a letter of approval from the Director of the DEQ be allowed to sunset on June 5, 2006, three years after the effective date of Public Act 14 of 2003, as specified in the Act. After that date, an individual permit for this activity should be required under Parts 325 – Great Lakes Submerged Lands, and 303 – Wetland Protection, of the Natural Resources and Environmental Protection Act (except for a limited General Permit as discussed below).**

   The Department would typically recommend issuance of an individual permit for vegetation removal to control invasive species such as *Phragmites*; and to

maintain recreational areas in public parks in accordance with approved park management plans. Permits may also be issued on a case-by-case basis where a clear need is demonstrated, damage to coastal habitat and impacts to neighboring properties would be minimal, and mowing is not a viable alternative. However, permits for vegetation removal will not be issued in designated Environmental Areas or where threatened or endangered species would be impacted, unless it is to control invasive species under a Department approved plan.

The Department proposes development of a simplified permit application form for vegetation removal to be prepared in cooperation with the Detroit District Corps of Engineers. The Department anticipates action on completed applications using the simplified form within 60 days (well within the average Corps processing time of 151 days), with a goal of 30 days.

Issuance of a limited General Permit for removal of vegetation from a 6 foot wide walkway to allow access to open water is also recommended (except where designated Environmental Areas or threatened or endangered species would be impacted).

2. **That exemptions for beach maintenance activities including raking, mowing, leveling of sand, and establishment of raised paths continue only until November 1, 2007, as specified in Act 14.**

After this date certain beach maintenance activities will continue to be exempt under Part 303. These include: (a) manual de minimis removal of vegetation (hand pulling) in sparsely vegetated areas; (b) manual leveling of sand in unvegetated areas of beach above the current water's edge; and (c) manual raking of sand in unvegetated areas to remove debris, without disturbing or destroying plant roots.

The Department recommends issuance of a new General Permit as of November, 2007 to cover the following additional beach maintenance activities: (a) mowing of vegetation twice per season to a height of not less than two inches, in an area not to exceed 50% of the width of the property, or 40 feet in width (whichever is less); (b) mechanical leveling of sand in unvegetated beach areas above the current water's edge; and (c) construction and maintenance of a temporary path up to 6 feet in bottom width to provide access to open water, to be constructed of sand and pebbles from unvegetated bottomlands or upland riparian property.

An individual permit would be required for other beach maintenance activities, including: (a) grading or leveling of sand that would alter the natural shoreline; (b) mechanical raking or disking of beach areas that will result in loss of vegetation or degrade habitat quality on the beach or in adjacent waters; and (c) large scale or frequent mowing that would significantly impact vegetation.

In evaluating permit applications, the impact on adjacent property owners and

on public resources would be considered.

Permits for beach maintenance will not be issued in designated Environmental Areas or where habitat for threatened or endangered species would be adversely impacted, except to control invasive species under an approved management plan.

3. **That the Department provide additional information to the public to discourage practices that were not intended to be exempt, such as mowing followed by "thatch removal" -- which is not included in the definition of either mowing or raking under Public Act 14 of 2003; or filling of vegetated wetland swales under an exemption for "leveling of sand in areas that are predominantly free of vegetation."**

4. **That the Department provide additional information to actively discourage mowing of nuisance species such as *Phragmites,* since mowing fragments the stems of this plant, greatly accelerating the spread of this serious nuisance species.**

5. **Finally, that the Department continue to support research regarding the impacts of human activity on Great Lakes coastal wetlands, with particular attention to groups of organisms that were not evaluated as a part of this study (e.g. shorebirds, waterfowl, reptiles and amphibians) as funding becomes available. Additional information is also needed on the extent of soil erosion and alteration of the physical nature of the shoreline following vegetation removal and similar activities.**